

method, especially as the sun is the body most frequently observed.

It may be also of interest to notice an additional use of the Brent Tables. These are constructed on formula (1), Table III. giving the value of C for every degree of latitude from 0° to 70° , and of declination from 0° to 60° . Now (2) may be written in the form

$$2h = \frac{1}{C} \frac{dl}{dh}$$

So that if we wish to find during what time observations may be taken so that an error dh in the estimated longitude will not produce more than an error dl in the latitude, we have, if t be expressed in time,

$$t = \frac{15}{C} \frac{dl}{dh}$$

Thus in the above example, suppose it were required to find during what time observations should be taken, so that an error of a second of time in the estimated longitude would not produce more than an error of a second of arc in the latitude, we have

$$t = \frac{15}{1.23} = 12\text{m. } 11\text{s.}$$

In cases where the latitude and declination are of the same name and do not differ by very much, this time is very small, but when of different names in high latitudes t is considerable.

J. WHITE.

H.M.S. *Hawke*, Mediterranean Squadron.

Magnetism of Rock Pinnacles.

OWING to my absence from home, I have only just seen the letters of the Rev. E. Hill, M.M.S., and James Heelis, in NATURE of August 2 and 9, on the above subject. The writers have apparently overlooked the very interesting report by Profs. Rücker and Thorpe, published in the Brit. Assoc. Report for 1889, p. 586, in which it is shown that "all the principal masses of basalt in the kingdom form centres of magnetic attraction," and that "the Malvern Hills, though composed of diorite in which magnetic polarity can barely be detected, produce deviations of twenty minutes of arc at a distance of one mile from their axis."

The mineral magnetite is an original constituent of basic igneous rocks; and, owing to the action of gravity on this heavy mineral whilst the magma which contained it was still in a fluid or plastic condition, or to some other cause, it has sometimes segregated into masses, or has become more or less concentrated, in certain parts of igneous rocks. Two very interesting papers on gabbros, in which remarkable concentrations of magnetite have been observed, have quite recently been read before the Geological Society—one by Sir Archibald Geikie and Mr. Teall, and the other by Mr. Alfred Harker—in which the concentration observed in these rocks is accounted for in different ways. Rocks in which a local concentration of magnetite has taken place must have a very powerful effect on the magnet even at a distance.

In addition to original magnetite, basic rocks, especially those of igneous origin, contain secondary magnetite, and magnetic pyrites, formed by aqueous and other agents, out of the unstable minerals of which the original rocks were built up. Serpentine, for instance, usually contains secondary magnetite formed out of the mineral olivine, one of the principal constituents of the peridotite from which serpentine was derived.

Owing to the presence of the above original and secondary minerals, small hand-specimens of ordinary igneous rocks—even those in which special segregation of magnetite has not taken place—will generally be found, when examined, to attract a magnet more or less powerfully.

A suitable instrument for testing hand-specimens may be formed by attaching a small horse-shoe magnet to one arm of a chemical balance. After the equilibrium of the balance has been restored, place the hand-specimen under the magnet and raise it carefully. The balance will dip unmistakably towards the specimen if it contains an appreciable amount of magnetite.

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C. A. McMAHON.

Aurora.

In Barrhead, Renfrewshire, on Friday (14th), at 9.15 p.m., I witnessed the finest aurora I have observed for years. The luminous arch extended from south-west to north-east, and shortly

reached the zenith. The rapid fluctuations in the streamers were remarkable. There were no coloured bands. The moon, nearly full, was shining, rendering the appearance less vivid. In about fifteen minutes the auroral light began to wane.

Tynron, Dumfriesshire, September 18.

J. SHAW.

BRIGHT PROJECTIONS ON MARS' TERMINATOR.

THE appearance of bright spots on the surface of Mars has been long familiar to observers of this planet. An idea of the ease with which they may be observed can be gathered from the following words of Schiaparelli, our highest authority on Martian questions.

"It would not be difficult to find a series of hypotheses which would explain satisfactorily the appearance of the polar and other white spots by attributing them in some way to the evaporation of the supposed seas, and to the atmosphere of the planet whose existence is indisputable. But I consider it more useful to point out that these different white spots are, of all the species of appearances on Mars, the easiest to observe. They require only an instrument of moderate power and a very persevering attention. The . . . peculiarities concerning these spots show that they offer a field for the most interesting investigations, whose importance in the study of the physical constitution of Mars is obvious; and in this field useful work could be done by those observers who are not able to decipher the much more difficult details of the canals and their doubling."

Now the appearances of some of these spots in different positions on the planet's disc have been observed at times to undergo rapid changes in brightness, and it was, if we do not err, the distinguished observer just quoted who first pointed out the tendency of some of these bright regions to increase relatively in brightness as the terminator of the planet was approached.

Observations of more recent date than those just referred to, have, however, made us acquainted with other surface phenomena connected, perhaps, in some way with, but of more importance than, the bright spots, and these are the bright prominences or projections at the terminator.

It must be remembered, nevertheless, that bright projections may be of two kinds, optical and real.

The former is an effect of contrast. It may be brought about by the approach of a very bright spot to the terminator where the adjacent darkness tends to give it the appearance of a projection, or, in other words, it is the result of pure irradiation. As a somewhat parallel example may be mentioned the "drop" seen at the transits of Venus. That numbers of such spots have been seen at various times, can easily be shown by a brief examination of the records. Terby, for instance, in 1888, on several nights watched three such points, which, as they approached the western edge of the disc, became very bright, and before passing behind the planet, projected beyond the edge of the disc, as was the case with the polar cap. At Mount Hamilton, also, numerous similar observations at various times have been made.

The second kind of bright projection is that due to the physical peculiarities at the surface of the Martian globe itself, and may correspond to elevated highly illuminated regions. These were first observed at the Lick Observatory in 1890, at the Observatory at Nice, and at the Arequipa Observatory in 1892. The first prominences observed this year were seen on June 26 at Mount Hamilton, and since then have been more or less constantly watched.

To give the reader an idea of what actually is seen at the telescope when such a projection is under observation, an instance or two may not be out of place.

On July 5, 1890, at 10h. Pacific standard time, a sketch by Prof. J. E. Keeler, with the 36-inch, showed a narrow, elliptical, white spot from 1"5 to 2"0 long, projecting northward at a slight angle with the line of the terminator. Half an hour later the spot was within the disc, but still visible as an oval white patch on a darker background. The following day (8h. 3m.) Prof. Holden saw a projecting spot curved upwards and nearly meeting, and the smaller projecting spot some 2" farther towards the south. The lower spot changed very considerably its shape during the time of observation, about an hour, and was observed to be always situated at the end of a long bright stripe of the surface of the planet which lies north of Deuteronilus.

A second case may be taken from the observations of Prof. Hussey and Campbell, made at the opposition of 1892, on July 11, with the Lick instrument. They record that a most striking one (prominence) was visible when the observations began at 12h. 15m., and remained constantly in view for about two hours. Its shape changed a great deal during that time. At 13h. 25m. it was unusually prominent, and its outer extremity was perceptibly bent upward toward the south polar cap. On July 13 these observations were duplicated; the southern one of the two projections presented the hooked or bent appearance most strongly at 14h. 35m., just as it was seen two nights earlier at 13h. 25m. Allowing for the longer rotation period of *Mars*, the same point on the planet was under observation on the two nights.

A somewhat indirect reference to these bright projections made by the Arequipa observers is included in the statement made by Prof. W. H. Pickering, that "clouds have on several occasions been observed to project beyond the terminator and also beyond the limit, thus confirming the observations made at the Lick Observatory."

Besides the above-mentioned observations, inserted to serve as samples of what has been seen, many more, by different observers, might be given, but they are all of the same type, and undoubtedly describe the same phenomena. One principal fact about them seems to be that although their shapes undergo distortions of all kinds, due to the different directions of the illuminating source, their mean positions seem to be at all times more or less constant.

As they appear beyond the terminator, not too far from it and within the limb, and are brilliantly illuminated, the natural conclusion to draw from these is that they must either be the tops of high mountains lighted up by the sun, or clouds at a high altitude in the Martian atmosphere, rendered bright by the same source. The latter suggestion, which, in the face of the most recent facts, does not seem to have much weight, was put forward by Prof. W. H. Pickering, and their height above the surface of *Mars* was measured to be at least twenty miles: more recent measures indicate that these estimates are far too high. That they may be, and most probably are, mountain tops, is the most general explanation; and Prof. Campbell,¹ whose opinion coincides with our own, says they are "due to mountain chains lying *across* the terminator of the planet, possibly covered with snow in some cases, and in others not necessarily so."

The reasoning he adopts may be summed up as follows: On July 11, 1892, the Earth was approximately 39,000,000 miles distant. With powers of 350 to 520 the equivalent distances were reduced to 110,000 and 75,000 miles respectively, distances equal to one-half and one-third of that of our Moon from us. Now if, with the *naked eye*, one can see at the terminator of our satellite bright projections at a distance of 240,000, surely pro-

jections, if any, at much lesser distances should be visible on the Martian disc.

If they be due to mountains, a small calculation has shown that they need be only of a moderate height, entirely comparable with those on the Earth and Moon. The figures computed to represent the height of the hills, satisfying the July observations, represented an altitude a little more than 189 miles.

A well-observed fact, which strengthens the mountain theory to a certain extent, is the presence of extremely brilliant star-like points which have appeared both on and off the snow-cap. If these are really mountain-tops, they should be always visible under suitable illumination, for when seen on a background of snow their height should enable them to catch all available light for reflection; and, secondly, when observed on darker surroundings (as when the snow serving as a background has melted), their height would still serve the same purpose, besides preserving for them their snow-capped peaks. The constancy in position of these spots shows that they are rigidly connected with the surface, and not due to the atmosphere, unless they be looked upon as stationary clouds or mists, which does not seem likely in the Martian atmosphere. Mr. Lowell this year has observed and measured some, the positions of which correspond with the measurements made by Green in 1877.

In Prof. Holden's mind the mountain theory seems to be thoroughly conclusive, for at Mount Hamilton, night after night, and even month after month, the prominences on the planet appear in the same longitudes and latitudes, inasmuch that a map of some of the chains is in preparation.

The positions of these brilliant spots on the globe of *Mars*, just referred to, lie much nearer the South Pole than those which have appeared as projections. This shows that we must not look upon the Martian surface as very flat, but as one studded with hills and dales, if we have such indications of unevenness as we are led to believe.

It may be remarked here that at Mount Hamilton and at Nice no bright prominences have been seen outside the limb, the only observations of such a nature of which we are aware being those of Martian clouds at Arequipa, where, Prof. Pickering states, "clouds have on several occasions been observed to project beyond the terminator and also beyond the limb."

In considering the visibility of mountains at the terminator and at the limb, certain important points must, as Prof. Campbell says, be taken into account.

In the first place, to obtain the greatest "seeing effect" at the terminator, it is not so much the height of the mountain in question, but the length of its chain that is the chief function. On the other hand, a mountain at the limb is seen simply by virtue of its *height* above the general surface, the *length* of the chain in this case being entirely eliminated. It must not be forgotten, however, that we view *Mars* from the earth, and not from the sun. This fact, combined with the different positions of the planet's axis at the times of opposition periods, accounts for the innumerable ways under which mountain chains can be illuminated, rendering them sometimes visible and sometimes invisible, according to the conditions in vogue. For instance, in 1890 the mountainous part observed was in the region a little to the north of Tempe (lat. 40° N., long. 45°). In 1892 the projections were chiefly observed about the region of Noachis (lat. 30° to 50° S.), two small ones being remarked at 25° S. lat. At Nice projections were noticed in approximately the same position, and in addition at 30° S. lat. and 220° long. to the south of Hesperia.

Such, then, are some of the facts and deductions to which a discussion of the observations of these prominences, made up till now, has led us. There is, no

¹ "An Explanation of the Bright Projections observed on the Terminator of *Mars*," by W. W. Campbell. *P. Astronomical Society of the Pacific*, vol. vi. No. 35, p. 103.

doubt, much to be learnt before we can say with certainty that we are dealing with mountain ranges pure and simple; but, as Prof. Campbell says, this hypothesis is a good one to work upon. The explanation, which assumes the presence of clouds, does not, as previously hinted at, seem to be any longer tenable, for would not permanent clouds (as these must necessarily be) at a considerable height mean land at a high altitude, and therefore mountains?

Those making measures of the positions of projections on the Martian terminator may find the following method of procedure, recommended by Prof. Campbell, serviceable:—"Marth's valuable ephemeris of Mars gives the 'position angle of the greatest defect of illumination.' With the micrometer wires set to that position angle, place the fixed wire tangent to the upper limb and bisect the projection with the movable wire. Again, place the fixed wire tangent to the lower limb, and bisect the projection with the movable wire. The diameter of the planet should also be measured, without changing the position angle of the wires. Irradiation caused by the bright polar cap is liable to increase some of the distances measured, especially with small telescopes."

Before concluding this brief summary, a few words may be added with respect to a recent note which appeared in these columns (p. 319), entitled "A Strange Light on Mars." The note in question was based on a telegram issued by the International Bureau, and referred to an observation made at the Nice Observatory. The "strange light" alluded to was regarded by the writer as referring to something quite exceptional, and *not* to the well-known prominences which during 1892 were so often seen, and which during this present period of opposition have been observed and measured several weeks before the telegram was dispatched.

W. J. S. LOCKYER.

NOTES.

THE funeral of Prof. von Helmholtz took place on September 13, at Charlottenburg. Among the numerous tributes of admiration were magnificent wreaths from the German Emperor and the Empress Frederick, both of whom were represented at the ceremony. Most of the learned societies of the capital and many of the Universities and scientific bodies in other parts of the Empire also sent representatives. Among those present at the funeral were Baron von Marschall, the Secretary of State for Foreign Affairs, Count Eulenburg, Dr. Miquel, Dr. von Bötticher, Herr von Schelling, and Herr Thielen.

WE are glad to learn that the Technical Education Board have made a grant of £500 to Bedford College (for Women), to aid in the full equipment of the laboratories of that institution.

THE *Lancet* states that the trustees of the late Mr. Richard Birdge have, with the consent of the Attorney-General, now handed to the British Institute of Preventive Medicine the residue of the legacy, amounting to over £20,000, for the purpose of building and endowing a laboratory for the chemical and bacteriological examination of water-supply and the investigation of processes of sewage purification. The permanent laboratory is now in course of erection on the site secured by the Institute at Chelsea, but, pending its completion, a temporary laboratory has been fitted up in order that the work may be at once proceeded with. Mr. Joseph Lunt, formerly assistant to Sir Henry Roscoe, has been appointed by the Institute to carry on this work under the director's supervision. The Institute is now, the *Lancet* understands, prepared to undertake the bacteriological and chemical examination of any samples of water which may be submitted. In addition to this,

the Institute will give expert assistance in the bacteriological or pathological diagnosis of any pathological material. The demand for this kind of work has greatly increased, so much so that, although Dr. Ruffer will still retain charge of this department, a specially trained bacteriologist has been appointed to work under his direction. Particulars may be obtained by writing to the director at the temporary offices of the Institute, 101 Great Russell Street, London, W.C.

ACCORDING to the *British Medical Journal*, a Clinical Research Association has been formed, under the patronage of Sir James Paget, Dr. Wilks, Mr. Jonathan Hutchinson, Sir W. H. Broadbent, Sir George Humphrey, Dr. Clifford Allbutt, and others, with the object of assisting medical practitioners in the investigation and treatment of disease by furnishing trustworthy reports upon excretions, tumours, and other morbid products. A laboratory has been fitted up, and will be under the direction of Dr. J. Galloway and Messrs. J. H. Targett and F. G. Hopkins. Further particulars of the Association can be obtained from the secretary, Mr. C. H. Wells, 5 Denman Street, S.E.

A MEDICAL School for Women is to be established by the Russian Government at St. Petersburg. This step, which is said to be due to the influence of Prince Wolkowski, acquires additional importance from the fact that only a few years ago the Ministry of Instruction was strongly opposed to every movement favourable to the higher education of women. The fate of the new institution will, we hope, be happier than that of the one established by Prof. Gerie, which was closed in 1884.

AN international Congress of Chemistry and Microscopy will be held in Vienna during the last week of the present month. Dr. E. Ludwig is the president of the committee of arrangements, and the secretary is Dr. Hans Heger, I. Kolowratring, Pestalozzigasse 6, Vienna.

WE notice that in the Universal Exhibition to be held in Paris in 1900, there are to be sections devoted to hygiene, military and naval hygiene, and medicine and surgery.

INFORMATION has been received respecting an Exhibition of Industry which is to be held at Kioto from April 1 to July 31, 1895. The exhibition is the fourth of the kind organised by the Japanese Government, and will be divided into classes under the following heads:—Manufactures, Fine Arts, Agriculture, Waste Products, Education, Mines and Mining, and Machinery.

WE have on several occasions referred to the great landslip at Gohna, and on July 5 printed an illustrated abstract of the report upon it by Mr. T. H. Holland. The dam, as readers of our notes for August 30 are aware, burst on August 26, and, as a consequence, very considerable destruction of property ensued. Further information respecting the occurrence has now reached England, and the *Times* of Saturday last published the following interesting details received from a correspondent:—"On August 24, at 8 o'clock in the morning, an automatic bell, placed within a foot of the top of the dam, sounded the first note of alarm. The warning was communicated throughout the whole of the threatened territory almost instantaneously by means of telegraphic messages, bonfires, rockets, the beating of drums, and other signals, and the people immediately fled, with all their cattle and personal belongings, into the hills. In this way ample warning was given and the apprehended loss of life averted. Three hours after the first signal the water reached the lowest point of the ridge, and the officials thought it expedient to block the passage through which the torrent would first escape, so that the lake should not overflow